



## FRD Activities Report August 2002



### In Memory of Dr. Timothy L. Crawford, FRD Director (1998-2002)

The Field Research Division (FRD), Air Resources Laboratory (ARL), National Oceanic and Atmospheric Administration (NOAA), and the scientific and aeronautical community suffered a tragic loss with the passing of FRD Director Dr. Timothy L. Crawford on August 3, 2002. He was 53 years old. Tim brought to FRD unabashed enthusiasm for science and life. He was a man who always focused on the positive and avoided dwelling on the negative. As FRD Director for nearly four years, he gave every staff member “ownership” of the division. Tim encouraged all of the FRD staff to strive for excellence. He trusted every staff member to do their job and treated each with courtesy and professionalism. He believed in doing what was right. He believed in education and outreach to youngsters willing to learn more about science and the world around them. Tim’s favorite line was *“it’s not about the flying, it’s about the science.”* Tim wanted to make a difference. He did.



**Figure 1.** Tim Crawford with the LongEZ N3R.



**Figure 2.** Tim Crawford with the Extreme Turbulence (ET) probe at the 2001 AMS Annual Meeting.

Tim suffered a massive stroke while piloting the LongEZ during a research flight on Saturday afternoon, August 3, 2002 for the CBLAST-Low field study over the Atlantic Ocean south of Martha’s Vineyard, Massachusetts. As a result, the LongEZ crashed into the ocean and was destroyed. A series of online articles discussing the crash have been compiled and can be found at <http://www.noaa.inel.gov/n3r>.

Tim was born in Springfield, Illinois on September 21, 1948. He earned his B. S. in thermal sciences in 1971 from the University of Illinois. A year later, he earned his M.S. in

Air Resources from the same school. Tim was awarded a Ph.D. in 1977 in Geophysical Fluid Dynamics from the University of Waterloo. He was an Electronics Engineer from 1970 to 1972 with the Dicky-John Company. Tim then began his federal career in the Air Quality Branch of the Tennessee Valley Authority (TVA) in 1972 as an Environmental Engineer. From 1979 to 1986, he was the Supervisor of the Atmospheric Physics Unit in TVA. In 1986, Tim was hired by NOAA as a Physical Scientist in ARL's Field Research Division in Idaho Falls, Idaho. Two years later, he transferred to ARL's Atmospheric Turbulence and Diffusion Division (ATDD) in Oak Ridge, Tennessee. He became Chief of ATDD's Air-Surface Exchange Branch in 1992. Tim returned to Idaho Falls in 1998 as the Director of FRD. He had over 30 years of distinguished service to the Federal government.

Tim was an experienced pilot with more than 3000 hours of flight time and held a commercial instruments pilots license. He was a certified FAA aircraft builder with Aircraft and Powerplant (A&P) licenses. He was also an EAA Technical Advisor (#1692). He built five aircraft, including two LongEZs. Tim held professional memberships with the American Meteorological Society (AMS), the American Geophysical Union (AGU), the Aircraft Owners and Pilots Association (AOPA), and the Experimental Aircraft Association (EAA). He was an EAA Chapter President from 1983-1986 in Muscle Shoals, Alabama.



**Figure 3.** Tim Crawford fabricating a new Best Aircraft Turbulence (BAT) probe.

Tim's true love was using the LongEZ as a tool for examining various environmental research problems. He used his extensive knowledge of meteorology, engineering, and aeronautics to create an ideal platform to measure air-surface exchange. The LongEZ and its suite of state-of-the-science sensors was a truly innovative platform for measuring turbulent fluxes of heat, moisture, mass, and momentum. Tim was one of several team members that won the NOAA



**Figure 4.** Tim Crawford with the LongEZ at EAA's AirVenture 2002 in Oshkosh, Wisconsin.

Administrator's Award for the Twin Otter instrumentation effort in November 1995. In October 2000, he was awarded a NOAA Bronze Medal for the design and application of a novel airborne instrument system to advance knowledge of air-sea exchange. Tim was an author or coauthor of more than 100 journal articles, book chapters, conference papers, and technical reports. He was an author or coauthor of nearly 30 peer-reviewed articles that appeared in various prestigious journals including the *Journal of Geophysical Research*, *Boundary-Layer Meteorology*, *Global Change Biology*, and *Monthly Weather Review*.



Tim will be sorely missed by his family, friends, and colleagues. However, he will not be forgotten. He has touched so many lives in ways that can not be measured. From all of us at FRD, thank you, Tim, for making a difference.

## Research Programs

### *CBLAST-High*

Installation was completed of the BAT system on the NOAA P3 N43. Jeff French along with engineers at NOAA's Aircraft Operations Center (AOC) in Tampa, Florida completed the testing required for FAA certification of the BAT probe mounted on the P3. After assembling the BAT probe in Tampa earlier this month, the probe was put through a series of static load and vibrational tests (Fig. 5), followed by a "functional" test flight (Fig. 6) to demonstrate that the instrument would hold up under flight loads. After completing these series of tests, analysis from data taken from the accelerometers within the BAT itself showed that no unforeseen vibrational modes were created within the probe/nose boom assembly. The data will be used by AOC engineers for a report to be submitted to the FAA for certification of the installation.



**Figure 5.** Vibrational testing of the BAT probe on the P3 boom.



**Figure 6.** The BAT probe seen from the cockpit of the P3 during a test flight.

September, as a number of systems in the Atlantic and Gulf of Mexico look promising. (Jeff.French@noaa.gov)

A series of data test flights were also conducted in August. Preliminary analysis of data collected during these flights indicated that the BAT probe, infrared gas analyzer (IRGA, Fig. 7) and data acquisition system were operating properly. Initial results look encouraging and more rigorous analysis will be carried out in the upcoming months. The system has yet to fly through a hurricane, but flight plans call for a data (hurricane) flight in early



**Figure 7.** IRGA on the P3.

### *Refractive Turbulence Study (RTS)*

Over half of the allotted flight hours have been flown in the first week of the Refractive Turbulence Study (RTS) being conducted in Adelaide, Australia in collaboration with the Air Force Research Laboratory (AFRL) and Airborne Research Australia (ARA). Conditions have

been excellent, as a jet core with significant vertical shear has been relatively stationary just north of Adelaide, leading to moderate levels of clear-air turbulence.

One of the goals of this year's study was to integrate FRD's Fast Ultra-Sensitive Temperature (FUST) sensor into the two BAT probes carried by ARA's Egret. Data from the FUST during these early flights has looked extremely promising.

One of the problems with the original BAT temperature sensor was its inability to resolve temperature fluctuations at high frequencies when signals were weak. The FUST appears to be doing a much better job, both resolving weak signals and responding to rapid fluctuations. Analysis of the data so far collected continues. (Jeff.French@noaa.gov)

### ***CBLAST-Low***

Participation in the Coupled Boundary Layers Air-Sea Transfer light-wind (CBLAST-Low) field study ceased when Dr. Timothy L. Crawford suffered a massive stroke while piloting the LongEZ research aircraft over the Atlantic Ocean on August 3, 2002. Tim was flying the second mission of the field study. Research is expected to continue for CBLAST-Low in FY-2003 and FY-2004 from data acquired by the LongEZ in a pilot field study from July and August 2001. (Jerry.Crescenti@noaa.gov)

### ***IMS Development Project***

The primary focus of the IMS Development project was to redesign the ion gate. The current ion gate uses a fiberglass/epoxy printed circuit board with a vacuum epoxy to insulate the wires that form the gate. Both the circuit board and the vacuum epoxy have been identified as primary contributors of interfering contaminants. We have ordered new printed circuit boards that will be constructed out of alumina ceramic that will not require any insulating compound. They are scheduled to arrive about September 10, 2002. We have also worked on improving the electronic amplifier and have a prototype that improves the signal to noise ratio several times over the current amplifier. (Roger.Carter@noaa.gov, Randy Johnson, Shane Beard, Debbie Lacroix)

### ***ET Probe***

Three ET probes are expected to be ready for field deployment at the beginning of September. Dave Auble at ATDD has designed deployment kits that will be used with the probes. These include igloo enclosures (Fig. 8) for the notebook computers and batteries that will power the probes. Contacts have been made with staff at the AOML Hurricane Research Division for coordinating the ARL deployment with other groups involved in tropical cyclone research. Based partly on the pressure sensors that have been installed in the ET probes, it



**Figure 8.** Enclosures that will contain the ET probe computers and batteries.

has been decided that the minimum sustained wind speeds that would be of interest are in the 25-30 m s<sup>-1</sup> range. This corresponds to a strong tropical storm that is just under Category 1 hurricane strength. In theory, the probes may work down to 10-15 m s<sup>-1</sup>, but such winds are not of scientific interest for tropical cyclone research. (Richard.Eckman@noaa.gov, Tom Strong, Ron Dobosy, and Dave Auble [ATDD])

### ***URBAN 2000***

An additional \$27k was received this fiscal year to complete a final report for URBAN 2000, the SF<sub>6</sub> dispersion study conducted in Salt Lake City in October of 2000. The meteorological portion of the study has already been reported in NOAA Technical Memorandum OAR ARL-243, *Meteorological Measurements During the URBAN 2000/VTMX Field Study*, by K. L. Clawson and G. H. Crescenti. The remainder of the study will be reported in a new NOAA Tech. Memo. currently in preparation.

## **Cooperative Research with INEEL**

### ***INEEL Support***

Several staff members toured ten of the 32 mesonet towers on August 28, 2002. The tours are being conducted to familiarize new employees with the tower locations and their equipment as well as reacquainting those that use the data. The remaining towers will be visited within the next month. (debbie@noaa.inel.gov)

An additional \$30k was committed by DOE-ID to investigate the upgrading or replacement of FRD's atmospheric transport and dispersion model known as MDIFF. It is clear that MDIFF is showing its age although it was state of the art some 10 years ago. Some presently accepted calculation routines are missing from the model. The Emergency Management group of BBWI (INEEL's maintenance and operations contractor) and the State of Idaho's INEEL Oversight group want to see separate concentrations for selected radiological isotopes and deposition included in the model. We would like to see inclusion of a 3-D wind field and terrain-following capabilities. A working group from the four groups and agencies will be established to hash out the details. (Kirk.Clawson@noaa.gov)

Some initial investigations have been made into finding a possible replacement for the MDIFF puff model currently being used to support INEEL operations. One possibility is the APGEMS model developed at Pacific Northwest National Laboratory. It is a puff model like MDIFF, but also includes improved wind-field modeling in complex terrain and algorithms for computing deposition and radiological doses. However, APGEMS may still be in the development stages, and it is not clear whether it has been evaluated using field data. Another model being considered is CALPUFF. It is well documented and has been thoroughly tested. On the minus side, it is mainly geared towards EPA regulatory applications rather than emergency response, and it appears to have no radiological algorithms. ([Richard.Eckman@noaa.gov](mailto:Richard.Eckman@noaa.gov))

### ***INEEL Mesoscale Modeling***

A new Dell workstation with dual Intel Xeon 2.4-GHz processors arrived in July. It will eventually run the daily MM5 forecasts for the INEEL region, replacing the current Alpha workstation. Most of the MM5 source code has been compiled on the new computer using the recently released Intel FORTRAN 90/95 compiler. There has not been a lot of experience compiling MM5 with this compiler (the Portland Group FORTRAN compilers have usually been used on Linux workstations), so it has taken some effort to get the code working. It has been particularly difficult getting the OpenMP directives, which are used to take advantage of multiple processors, to work properly. Some initial test runs of MM5 indicate that the dual processors are not providing as much of a performance boost as was originally hoped. In spite of this, the new machine still runs MM5 faster than the Alpha workstation it will replace. The main problem that remains is to get the RIP package, which produces graphics of the MM5 output, working on the new machine. This package keeps on producing run-time errors that appear to be associated with the FORTRAN BACKSPACE statement. It is not clear whether these errors are related to a compiler bug or something else, such as a stack overflow.  
(Richard.Eckman@noaa.gov)

### **Other Activities**

#### ***ARL Director Visits FRD***

Bruce B. Hicks, Director of the Air Resources Laboratory (ARL), was in Idaho Falls August 30, 2002 to visit the Field Research Division. His visit was in response to the tragic death of FRD Director Timothy L. Crawford who died on August 3, 2002 while flying the LongEZ research aircraft during a CBLAST-Low mission. Bruce discussed the future of FRD and the small environmental research program (SERA). Kirk Clawson, FRD's Deputy Director, was appointed acting director until a new permanent director can be selected.

#### ***Keynote Speaker at AMS Meeting***

Jerry Crescenti has been invited to be a keynote speaker at the Twelfth Symposium on Meteorological Observations and Instrumentation (12th SMOI) in Long Beach, California on February 10, 2003. He will present a talk entitled "In Memory of Dr. Timothy L. Crawford, NOAA/ARL, Idaho Falls, Idaho." The 12th SMOI is being held in conjunction with the 83rd Annual Meeting of the American Meteorological Society.

#### ***Papers***

Crescenti, G. H., 2003: In memory of Dr. Timothy L. Crawford, NOAA/ARL, Idaho Falls, Idaho. Preprint, *Twelfth Symposium on Meteorological Observations and Instrumentation*, Long Beach, CA, Feb. 9-13., Amer. Meteor. Soc., in preparation.

### ***Travel***

Debbie Lacroix traveled to Seattle, Washington from August 2-8, 2002 for a safety training course entitled "Collateral Duty for Other Federal Agencies."

Jeff French was at Hyannis, Massachusetts through August 7, 2002 to assist in the set up for the CBLAST-Low field study. He flew directly to Tampa, Florida to instrument one of the NOAA P3 aircraft with the BAT probe for the CBLAST-High field study. He returned to FRD on August 15, 2002.

Jerry Crescenti was in Hyannis, Massachusetts through August 8, 2002 to conduct the CBLAST-Low field study.

Tim Crawford was at Hyannis, Massachusetts through August 3, 2002 to participate in the CBLAST-Low field study.

Jeff French traveled to Adelaide, Australia on August 24, 2002 and is scheduled to return September 18, 2002. He is participating in the Refractive Turbulence Study (RTS) with Jörg Hacker and Owen Coté.

Other travel scheduled for this month (Tami Grimmett to Hyannis and Paula Fee to Boulder) was cancelled due to the untimely death of FRD Director Timothy L. Crawford.

### ***Training***

Debbie Lacroix participated in a safety training course entitled "Collateral Duty for Other Federal Agencies."